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Study on the food preference of the Acridid grasshoppers (Orthoptera: Acrididae)

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ABSTRACT

Food plant preferences in three acridid grasshoppers, Chtotogonus trachypterus, Acrida exaltata and Oxya velox were determined providing selected plant species in the laboratory. Twenty food plants were collected from the fields and small pieces or leaves of selected plants were given to test insects for their choice test within period of consecutive 30 minutes. The grasshopper-plant association was analyzed based on the preference to eat the given plant material. Some plant species were found to be most preferred host plants, whereas others were rejected. Acridid grasshoppers showed high food preferences to grass, wheat, gram, maize, bajra, oat, cauliflower and cowpea belonging to the family Poaceae, Fabaceae, Solanaceae, Brassicaceae and Leguminoseae, respectively. Some plant species such as chaulai, pyaji and coriander were less accepted. The choice of the food plant is significantly associated with the physical and chemical composition of the plant material that might be rich in water, nutrients and freshness of food.

Keywords: *Chtotogonus trachypterus, Acrida exaltata, Oxya velox,* acridid grasshoppers, feeding preference

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INTRODUCTION

Acridid grasshoppers are mostly polyphagous and prefer a variety of plant species in a wide range of habitats. They don't equally accept all the vegetation though show some degree of selection measure with specific choices for the certain type of plants they consume. The distribution and abundance of the acridid grasshoppers is associated with the availability of host plant in the definite area to attain highest biotic potential by using them as food. Several studies revealed that food plant selection and their consumption are directly linked with the growth and life cycle of a grasshopper while, their population turns down abruptly when the suitable plant species are vanished [15]. The findings pointed out that seasonal vegetation affects the temporal and spatial distribution of the grasshoppers [21]. Therefore, the distributions of grasshoppers are directly correlated with the availability of preferred food plants.

The host plant selection greatly depended on the physical and chemical elements such as water content and freshness of food [2]. Food plants are recognized to influence the biology and behavior of insects as well as rate of growth and development, fecundity, fertility and survival [5, 6]. The early stages of acridid grasshoppers preferred weeds while the late stages preferred more succulent food plants [27, 28]. Grasshopper is a serious pest of young plants, especially the seedling of wheat (*Triticum aestivum*), berseem (*Trifolium alexandrinum*), millet (*Pennisetum typhoideum*) and cotton (*Gossypium hirsutum*) [3]. Polyphagous herbivores feed on plants belonging to various families whereas most polyphagous species prefer only on dicotyledonous and fewer feed only on monocotyledonous plant family, although most species fall in the group of the oligophagous to polyphagous. The qualitative and quantitative necessities of a grasshopper are not fixed and vary with the stages of growth and development, reproductive status, and behavior of the insect [8, 16]. Phytochemicals, alkaloids and tannins were found as feeding deterrent in some vegetation [20, 25]. Many workers have revealed that food plants exert influence on the development, fecundity, hatchability, and longevity of acridid grasshopper so they have levels of their selection [10, 17 & 29]. The present work aims to study the food preferences to commonly selected plant species by three species of acridid grasshoppers, *Chtotogonus trachypterus, Acrida exaltata* and *Oxya velox.*

MATERIAL AND METHODS

Adults and nymphs of three acridid grasshoppers, *Chtotogonus trachypterus, Acrida exaltata and Oxya velox* were collected from the agricultural field and grasslands in the Jaipur. These species were cultured

at laboratory conditions (32 ± 2°C and 60 ± 5% R.H.) in wooden cages each measuring 60cm x 40 cm x 60 cm with glass sheet in one side to see activities of grasshoppers and provide food plants leaves. Newly hatched hoppers were kept in the glass jars (15 × 20 cm) and the jars were covered with muslin cloth tied with rubber band. They were fed twice daily on cauliflower leaves.

Food plant material was arranged from the local market and nearby field. Leaves of plants were washed under running tap water to keep away from contamination and kept for well wiped out of water. Food preference experiment was run on twenty different food plants depicted in the table (Table-1). All host plants were compared with *Cynodon dactylon* (doob/grass) used as control plant species. Food preference study was carried out according to the method of [12] with slight modifications.

Feeding Test

For the acceptability and food preference tests, fifty mature grasshoppers were used for each trial. Before each experiment all the fifty grasshoppers were kept starved for 18 hrs in the cages. Each experiment was carried out by placing twenty host plants leaves in the cage then after adults were released for feeding on them simultaneously. All grasshoppers started to feed with a random feeding pattern within 5-15 minutes when liberated in the cage on selected plant leaves according to their choice. Numbers of grasshoppers were counted when feeding on food plant leaves after three consecutive 30 minutes (30, 60, 90 minutes) intervals, respectively. In next the examination, these plant samples were altered in their position. All further experiments were followed by placing the rest plant samples in the cage and feeding grasshoppers were counted. The experiment was replicated at least three times as each grasshopper was given the option to choose for three times on each food plant sample.

The value of food preference was found out as the number of grasshopper feeding upon food plant leaves in comparison to the number of grasshopper feeding on the control diet. Data on the frequency of grasshopper's feeding on each food plant species as well as on the frequency of feeding signs on each plant species were statistically analyzed using the one way ANOVAs test.

RESULTS

The three species of acridid grasshoppers, *Chtotogonus trachypterus, Acrida exaltata and Oxya velox* were examined for their choice test to offered food plants. These grasshoppers' species exhibited some extent of food preference among twenty plant species presented for choice tests (Table-1).

For 50 grasshopper species the principal host plants and preferred food plants were determined. Test insects accepted all the food plant leaves which offered them more or less choices. Out of 20 plant species pertaining to families Poaceae, Fabaceae, Solanaceae, Brassicaceae and Leguminoseae were highly accepted. Generally, when the grasshopper started to feed plant leaf it shows grooming of the antennae, patting the leaf surface with them and also with mouth apparatus. In some cases, it frequently jumps to the walls of the cages. Some plant species were less accepted such as chaulai, pyaji and coriander. The most frequently accepted plants were grass, wheat, gram, maize, bajra, oat, cauliflower, cowpea and all were observed with the higher frequency of choice. The leaf structures exposed to feed which could serve as a source of food for the grasshopper. The time period of starvation is strictly valued because the loss of water and deficiency of food contents in the insect body for long periods of time make the test insects more or less selective to types of food samples [7].

Chrotogonus sp. showed a definite high preference for oat, grass, wheat, cauliflower, cabbage, gram, bajra while moderate preference observed to cowpea, maize, moong, tomato, sugarcane, groundnut, alfa-alfa, bathua followed by spinach, brinjal, coriander, pyaji and chaulai**.** While, *Oxya sp.* most frequently preferred gram, cauliflower, grass, oat, wheat, maize as well. While, sugarcane, tomato, moong, bajra, bathua, cowpea were moderate preferred food plants and brinjal, spinach, coriander and chaulai were least preferred.

Acrida exaltata showed a high preference for oat, wheat, tomato, brinjal, grass, followed by alfa-alfa, gram, alfa-alfa, groundnut cowpea, maiz, bathua, sugarcane. Least preference was observed for coriander, bajra, spinach, pyaji, bathua and feeding on chauli did not notice. Although, chaulai and coriander had not been accepted much by all the grasshoppers. One way Anova test was found non- significant (p value 0.378 ≥ 0.05).

Table-1 Food plant preference by acridid grasshoppers

S.No	Botanical Name	Common Name	Family	*Chtotogonus trachypterus*			*Acrida exaltata*			*Oxya velox*		
				30 min	60 min	90 min	30 min	60 min	90 min	30 min	60 min	90 min
1.	*Brassica oleracea* var. *capitata*	Cabbage	Brassicaceae	3.3	3.6	4.3	2.3	1.3	1.3	2.6	2.6	1.6
2.	*Brassica oleracea* var. *botrytis*	Cauliflower	Brassicaceae	3.3	4.3	4.3	1.3	1.3	1.6	2.3	4.3	4.6
3.	*Lycopersicon esculentum*	Tomato	Solanaceae	3.3	2.6	2.6	3.3	4.3	4.6	-	-	2.3
4.	*Solanum melongena*	Brinjal	Solanaceae	1.3	1.6	1.6	3.3	4.3	5.3	1.3	2.3	-
5.	*Cicer arietinum*	Gram	Fabaceae	2.2	3	3.3	2	3.6	3.6	4	4.3	5.3
6.	*Medicago sativa*	Alfa alfa	Fabaceae	2	1.3	1.6	3	3.3	3	2.3	2.3	1
7.	*Arachis hypogea*	Groundnut	Fabaceae	2	3.3	3	2	3.3	3	2.6	-	1.3
8.	*Spinacia oleracea*	Spinach	Amaranthaceae	1	2	1.3	-	3	1.3	1	1.6	-
9.	*Triticum aestivum*	Wheat	Poaceae	2.3	3	4.3	3	4	5.3	3.3	2	4
10.	*Cynodon dactylon*	Doob/grass	Poaceae	2.3	4.6	4.6	3.3	2	4.6	4	3.3	4.6
11.	*Pennisetum typhoides*	Bajara	Poaceae	1.3	2	3.3	2	1.6	1	1.6		2
12.	*Vigna unguiculata* W.	Cowpea	Leguminoseae	1.3	2	3.3	2	2.6	3.6	1	1.3	2
13	*Zea mays L.*	Maize		2	2.3	3.3	2	2.3	1	1	2.6	3.6
14.	*Coriandrum sativum*	Coriander	Apiaceae	1	-	-	1.3	-	-	1	1	-
15.	*Asphodelus tenuifolius*	Pyazi	Asphodelaceae	-	1.3	1	-	-	1.3	-	-	1
16.	*Saccharum officinarum*	Sugarcane	Poaceae	1	2.3	2	1	1.3	1.6	2.3	2	3.3
17.	***Vigna radiata***	**Mung bean**	Leguminoseae	1	2.3	2.3	1	2.3	2	1	2.6	2.3
18.	*Amaranthus caudatus*	chaulai	Amaranthaceae	-	-	1	-	-	-	1.3	-	-
19.	*Chenopodium album*	Bathua	Amaranthaceae	2	2	1.6	2.3	1	2.3	1	1.6	1.6
20.	*Avena sativa*	common oat	Poaceae	3	3.3	5	4.3	4	5.3	3	3.6	4.3
One way ANOVA F value- 1.081407347, Non-significant (P value-0.378422756865169≥ 0.05)												

DISCUSSION AND CONCLUSION

The selection of food plants in polyphagous insects is identified as the cumulative effect of physical, chemical and sensory components [2]. All the acridid grasshoppers showed an almost uniform preference in their choice tests for commonly available plant species, particularly preference for grass and wheat followed by gram, maize, bajra, oat, cauliflower and cowpea were observed.

Earlier, Ananthakrishnan *et al* [2] reported that *Atractomorpha crenulata* Fab. preferred host plants belonging to Euphorbiaceae, Fabaceae, Solanaceae, Poaceae, Asclepidaceae and Amarantheceae and their occurrence was high on dicot plants mainly by nymphs. The early instars of *Gastrimargus transversus* Thunb. showed high preference to a variety of grasses only, whereas low preference was observed for crops. Food plants belonging to the family Gramineae were highly preferred. Whereas, *Hieroglyphus banian* Fab. mostly preferred the family Poaceae and Cyperaceae [9]. Similarly, Nzekwu and Akingbohungbe [23] revealed that the nymphs of *Oedaleus nigeriensis* developed rapidly when reared on a mixed diet of *Axonopus compressus, Eleusine indica, Cynodon dactylon,* and *Seteria gracilipes* (grasses) in comparison to a single host plant. Idowu and Sonde [14] reported that *Zonocerus variegatus* preferred cassava (*Manihot esculenta*) and mixed diet, than acalypha (*Acalypha wilkesiana*) and pawpaw (*Carica*

papaya). Plants belonging to the family Poaceae were most favored by *A. exaltata* [12, 22]. The *Acrida exaltata* (Walker) is the major pest of grass, paddy, wheat and sal also it damages paddy, maize, oat, wheat and vegetables (tomato, brinjal etc.). *Acrida* like to feed on *Oryza sativa* as most favorite plant and moderate rate of growth showed for *Triticum aestivum* and *Cynodon dactylon* while *Zea mays* whereas the least preferences showed to *Brassica oleraceae* var. botrytis [29].

Chrotogonus trachypterus Blanchard is commonly a surface grasshopper and well-known pest of maize, jowar, bajra, rice, millet, groundnut, sugarcane etc in the seedling stage. It showed a marked preference for certain solanaceous species, legumes, and cucurbits of economic importance, indicating it to be a potential pest of mature crops. Earlier *chrotogonus* had reported the high consumption of jute (*Corchorus capsularis*) and berseem (*Trifolium alexandrinum*) leaves being 68.67 and 67.00 % respectively. A grasshopper consumes a single diet for 1-3 minutes approximately. Although, the consecutive interval between two meals might be observed of 2-3 h [4, 26]. Rahman (24) studied that *Chrotogonus lugubris* Blanchard digest frequently beans and clover than wheat seedlings or cotton leaves. While, laboratory experiments on the Food preference of *Chrotogonus trachypterus* Blanchard indicate that the growth index for hoppers was maximum on lucerne followed by wheat. By contrast, nutgrass and pigweed had significantly the lowest growth index [13]. Haldar *et al* (12) and Nath *et al* (22) revealed that family Poaceae was most preferred by *Acrida exaltata* while, *Atractomorpha crenulata* preferred *Daucus carota, Adiantum caudatum,* and *Hemartheria compressa* the most amongst 13 plant species. Similarly, *Brassica oleracea* var. *botrytis* and *Saccharum officinarum* have an impact on the growth and development of *Acrida exaltata* Walker (29). *Oxya hyla* hyla showed high preference to *Sorghum halepense* and *cynodon dactylon, where, Oxya fuscovittata* had its maximum growth on *Oryza sativa* followed by *Cypersus rotundus* [11].

However, grasshoppers are polyphagous in nature but give preference to selected host plants for their growth and development. Therefore, the acridid grasshoppers don't damage all the plant species with equivalent severity. However, they demonstrate distinct choices that are influenced by the interaction between food contents and particular nutritional requirements of the insect. The present study allows us to know accurately the possible preferred food plants which are commonly available in the occupied habitats of acridid grasshoppers. It would help to predict their assemblage to a particular habitat and behavioral aspect.

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